OBJECTIVES

Upon completion of this module, the trainee will be able to.

1. List specific requirements for:
    - Meat
    - Meat byproduct
    - Sausage
    - Imitation sausage
    - Partially defatted beef and/or pork fatty tissue
    - Condiments (as they relate to meat and poultry products)
    - Emulsion
    - Specific loaves
    - Rework
    - Cured pork trimmings
    - Cold spots (in reference to smokehouses)
    - Poultry byproduct
2. List specific requirements that relate to identification, wholesomeness, and/or use of :
    - Meat products
    - Meat byproducts
    - Nonmeat ingredients
    - Rework products
    - Casings (natural, artificial, collagen)
    - Cured pork trimmings
3. Select, from a list of woods, those that are acceptable to FSIS for smoking meat products.
4. Given a list of percentages, select the percent water limitation for coarsely ground cooked sausages.
5. Given problems, accurately calculate:
    - The percent of proteinaceous ingredients (Group 2 Protein contributing ingredients) that must be identified on FSIS Form 10,600-1 when a sample of cooked sausage is submitted to the laboratory for the determination of added water.

- When two species of meat *or* two species of poultry are identified in the ingredients statement and connected with the word “and” instead of a comma,
  - ✓ The minimum combined weight of both ; and
  - ✓ The minimum weight of the lesser of the two.
- The minimum amount of liver required in products that by standard of identity require liver as an ingredient.
- The minimum of amount of partially defatted beef or pork tissue allowed in franks, bologna, etc. [§319.180(b)]
- The maximum amount of bacon ends and pieces allowed.
- The maximum amount of poultry allowed when added to products identified in:
  - ✓ §319.180(a) or (b)
  - ✓ §319.140

6. When given problems describing cooked sausage products, accurately calculate the maximum amount allowed of the following additives.
   - Sodium nitrite
   - Curing accelerators
   - Binders and extenders (those limited to 3½ %)
   - Isolated soy protein
   - Isolated soy protein in combination with other binders. (Amount of other binders will be given.)

Note

Throughout this module, terms will be used that are peculiar to the preparation of sausage. To aid you in understanding this section and to acquaint you with additional terms commonly used; a limited sausage glossary appears at the end of the module.

INTRODUCTION

Sausage is a food that is prepared by grinding or comminuting meat, adding various seasonings, and then forming the product into a symmetrical shape. The practice of stuffing salted, chopped meat flavored with spices into animal casings is an ancient custom, dating back to Grecian and Roman eras. Native Americans prepared a type of sausage consisting of chopped, dried meat, mixed with dried berries and pressed into cakes.

Sausage making was a way of preserving meat. As the population expanded geographically, the availability of raw materials and differences in climate lead to variations in manufacturing procedures. This resulted in typical flavors, textures, and shapes. Many sausages took on the names of the areas where they were thought to have originated. Many present-day sausages still carry those names. A few examples are frankfurter (Frankfurt, Germany), bologna (Bologna, Italy), berliner (Berlin, Germany), and Genoa (Genoa, Italy).

The processed food industry in the United States sprang from the diverse ethnic backgrounds of the immigrant population and a combination of circumstances. The advent of the railroad allowed the movement of vast herds of cattle to Midwestern depots for slaughter. After that, they were distributed to highly populated eastern communities.

During the Civil War, the federal government granted profitable contracts to the packing industry, which provided the industry with the capital necessary for economic expansion. About the same time that coolers were being installed in the large slaughter plants, the railroads were providing cars that could be iced. This allowed the slaughtering plants a lucrative way to use the cheaper, perishable cuts of meat, trimmings, and offal products.

They started manufacturing sausage items. Adding variety meats to sausage products without identifying the type of materials being used is an example of deception. With the addition of various spices, the consumer didn't always know what the sausage was made from based on its finished appearance. About this same time, Upton Sinclair wrote an expose entitled *The Jungle* that identified many undesirable practices in the larger packing houses. As a result, the Federal Meat Inspection Act (FMIA) was instituted in June 1906. Today,

we still allow the use of these lower quality cuts of meat and offal products in sausage, but we require accurate labeling so that consumers know exactly what they are purchasing.

At this point, let's review the definitions of several terms that appear in the standard of identity for a sausage product. "Meat" is muscle tissue from any cattle, sheep, swine, goat, or equine animal that is skeletal or that is found in the tongue, diaphragm, heart, or esophagus, with or without the accompanying and overlaying fat. It includes portions of bone, skin, sinew, nerve, and blood vessels normally accompanying the muscle tissue that are not separated from it in the dressing procedure. It *does not* include the muscle found in the lips, snouts, or ears.

"Meat byproducts" are frequently used in the preparation of sausage products. They must be listed in the ingredient statement of sausage. The term means any part derived from cattle, sheep, swine, goats, or equine animals, **other than meat**, that can be used as human food. Remember, that hearts, tongues, and weasands are considered byproducts when used in a sausage formula. Byproducts may also be referred to as "variety meats".

The term "sausage" refers to a product prepared with meat or with meat and meat byproducts, usually ground or finely comminuted, containing various amounts of water and usually seasoned with spices, seasonings, and flavorings ("condimental substances"). Any amount of condiment may be used up to the maximum amount needed to impart its normal characteristic flavor ("condimental proportion"). Sausage is frequently cured.

Sausages are best classified according to the manner in which they are processed. In the U.S. today there are over 2500 different varieties of sausage. Basically, these fall into four classes, which we'll identify as fresh, cooked and smoked, cooked, and dry or semidry. Since the fresh sausage regulatory requirements are addressed in the Fresh Sausage Operations Module, those requirements will not be discussed in this module.

Approximately 85% of all sausage produced today falls into the cooked and smoked class, with frankfurters (sometimes called franks, hot dogs, wieners, etc.) accounting for approximately 55% of all sausages produced.

The cooked and smoked class of sausage is characterized by the quality imparted to the product through the addition of nitrites, and in some case nitrates. Other factors to consider in the process are smoking and cooking. This class of sausage is almost always cooked in a smokehouse, which adds a distinct flavor and aroma to the product. These products may contain no more than 40% of a combination of fat and added water, but no more than 30 % fat in the finished product. Frankfurters, bologna, knockwurst, and Vienna sausages would be

examples of sausage products that have a 40% fat plus added water limitation.

Another type of cooked and smoked sausage, such as Polish sausage, salami, bierwurst, and the like, is usually coarsely ground. In these products where the fat is often visible to the consumer, there is no fat limitation. The visible fat is considered self-limiting. Added water is limited to 10% based on the finished product weight.

A third class of sausage is cooked sausage. Generally speaking, these products would be cooked in water. Some examples are braunschweiger, liver sausage, and specialty items such as blood sausage and tongue items. The usual method of cooking these products is to stuff the meat into an impervious casing or stainless steel mold and then place it into hot water until such time as the desired product temperature is reached. A 10% added water limitation is placed on these items since there is seldom any cooking shrink. The product normally retains all its moisture because of the casing or mold. Therefore, the plant should control the amount of water added at the time of formulation.

Last, but by no means least, is the class of sausage called dry or semidry. Most dry sausages are characterized by a bacterially induced fermentation. This intentional encouragement of lactic acid bacterial growth is considered useful for preserving, as well as attaining the desired typical tangy flavor of the product.

The ground and chopped meat ingredients are mixed with spices and curing ingredients. Sometimes the mixture is held for several days in a curing cooler. Afterwards, the meat is stuffed into casings and undergoes a carefully controlled air-drying process.

The two dry sausages most often produced are salamis and pepperonis, which are coarsely chopped. They may be smoked, unsmoked, or cooked.

The harmless bacteria starters are limited to 0.5%. Dry sausage may also have antioxidants added to protect flavor and help prevent rancidity. The antioxidants are limited to 0.003% individually and 0.006% in combination, based on the total weight of the product. Compliance determinations for antioxidants are covered in the Additives module.

Additional plant controls may include keeping accurate records of temperature and time (number of days the product was kept in the drying room). The records should include some method of identifying the product throughout the drying phase.

Compliance of dry sausage is determined by a moisture-protein ratio (MPR). Meat and poultry ingredients have a MPR of 4:1. This means four parts moisture to one-part protein. Drying only reduces the moisture content. Pepperoni is required to have no more than a 1.6:1 moisture-to-protein ratio, while Genoa has a MPR

of 2.3:1. All other dry sausages are restricted to an MPR of 1.9:1. The inspection program employee will sample product as directed to determine compliance.

The production of semidry sausage usually involves a combination of cooking and drying. These sausages are generally produced by adding an approved bacterial lactic acid starter, such as *Pediococcus cerevisiae,* to attain the typical tangy flavor. When a bacteria starter is used, it is limited to 0.5% in the product.

Cervelats, thuringers, Lebanons, mortadellas, are examples of semidry sausages. Depending on the method of processing, they sometimes are considered cooked sausages. Summer sausage is considered to be a semidry sausage. Some product standards allow the addition of binders, byproducts, or both. Because of the variety of semidry products being produced, it serves no purpose to list all the variations in this module.

There are many products being formulated that do not fall into one of these four classes. A few examples are loaves and products such as hamburger or ground beef. Since formulation and requirements for ground beef, hamburger, and similar products are discussed in the Fabrication of Meat and Poultry Products module, let's address loaf products. First of all, there are basically two types of loaves—specific and nonspecific.

The difference between the two can readily be determined by their product names. In the case of a specific loaf, or meat loaf, there is a reference in the product name to meat or a species of meat. Products labeled "meat loaf", "beef loaf", "pork loaf", "corned beef loaf", "baked pork loaf", "chicken loaf", and "veal loaf" would be considered specific loaves. On the other hand, a product with a name that does not refer to meat or a species of meat would be considered a nonspecific loaf. A few examples of non-specific loaves commonly produced today include "pickle and pimento loaf", "macaroni and cheese loaf", "New England brand loaf", etc.

Specific meat loaves that are cured cannot contain binders and are limited to 3% water based on total ingredients. The cure agents have regulatory limits, as discussed in the Additive's module.

The nonspecific loaves may contain approved binders, byproducts, fat and water without limitation. The only restrictions are on curing agents used and label accuracy.

If pork muscle is used in the preparation of a smoked and/or cooked sausage or cooked loaf, it must be treated for the destruction of trichinae either before formulation or before shipment. Pork muscle may be infested by the trichinae parasite. The parasite is so small that it can only be detected by a microscopic examination. That type of examination is not very practical in the everyday packing house operation, so FSIS requires that all pork muscle be treated to destroy trichinae. Any of the three methods (refrigeration,

heating, or curing) may be employed. Heating is probably the most common method used. An internal temperature of 144ºF is considered fatal to all trichina organisms. Since most cooked items are cooked to a temperature somewhat higher than 144ºF, the packer has little trouble destroying trichinae. However, there are some products that are partially processed to an internal temperature somewhat less than 144ºF. For example, smoked pork sausage (no *cure* added) would need to be treated by one of the other two approved methods. See Regulations §318.10(c)(1) for the chart listing control times and temperatures.

A controlled curing process is the method generally used for dry and semidry sausage product. FSIS Regulations identify five methods a packer can use. Basically, the method used will depend on the packer's needs.

All five methods have some similarities, such as a combination of amount of salt content, length of time in a drying room under specified temperature requirements, and size of chopped meat in the product. These methods of trichinae control are identified in §318.10.

PRODUCT PROCESSING

Formulation, (combing various meat and nonmeat items) is one of the most important phases of sausage making. In sausage preparation, the protein of the meat and/or poultry and water are combined (through chopping and mixing) to form a matrix that encapsulates fat, thus forming an emulsion. Basically, a meat emulsion is a semi-fluid mass with fat particles held or suspended in it by the meat and/or poultry protein and water.

The muscle protein, or myosin, has the ability to hold water and emulsify fats. Myosin is a salt-soluble protein. Salt solubilizes or releases the myosin from the muscle fibers. Some operations will grind the lean meat intended for a sausage item, add salt, and later incorporate the mixture, which by then has a very moist, pourable consistency, with the rest of the formula ingredients. In short, we could say that a sausage emulsion is the result of solubilized meat proteins and water combining to surround and encapsulate small fat globules. If the sausage is expected to maintain this structure throughout the stuffing and cooking cycles, several formulation factors must be considered.

When too much fat is added, there usually will not be enough protein to encapsulate the fat. This causes the sausage to "short out." Other terms used to describe this condition, are "greasing out" or "fat capping." There are times when the meat and/or poultry mixture is over chopped, which exposes more fat surface than the available protein can coat. This is just another example of "shorting out." Over chopping can also increase the meat and/or poultry mixture's temperature, which could cause some of the fat to partially render (liquefy). The protein is then unable to hold a " liquid fat" in suspension. High acid content of product (which in reality means a low pH) has been blamed in some instances for emulsion

breakdown. The rapid heating of products to a high temperature before the proteins can coagulate is yet another cause.

MEAT, MEAT BYPRODUCTS POULTRY, POULTRY BYPRODUCTS

All meat, meat byproducts, and poultry must be clean, sound, and wholesome. They may be fresh, cured, or cooked. Beef (carcass meat, cheek meat, head meat, hearts, livers, tripe, and tongue), pork (carcass meat, hearts, livers, stomachs, jowls (both skin-on and skinless), back fat, skins, and snouts), veal, mutton, and chicken/turkey (meat, chicken/turkey containing skin and fat not in excess of their natural proportions, skin, fat, hearts, gizzards, and livers) are among the many variations of meat and meat byproducts, and chicken/turkey meat and byproducts being used in sausage products today.

Of all the meat and poultry just mentioned, beef and pork are the most widely used. Beef contributes to the color. It is also high in myosin; therefore, it aids in the emulsion process. Lean beef muscle has good water-holding ability. Pork functions in much the same way. However, pork frequently has more fat, which could effect its shelf life. When large amounts of pork are used, the color of the product may be lighter. Mutton is a good source of protein and historically has been less expensive. Byproducts are also less expensive and are utilized for fillers, but they are not known for their water-holding ability.

There are several things that can go wrong with meat and poultry items. When directed to do so, the inspection program employee will check some of these potential problems during the operation.

Product from other plants is frequently frozen. Many times the sausage plants will hydroflake frozen meat. The receiving plant should check (by thawing) enough of the incoming meat to determine wholesomeness. The meat may have been old when it was packed or not properly rotated into use from the cooler. Even though boneless products coming into the plant have been inspected and passed, the plant must ensure that they are still wholesome at the time of use. The product might have been contaminated during transit or by the way it is handled after receipt.

Foreign odors in meat or poultry, such as ammonia, sourness, insecticides and the like are also possible. Poultry is especially prone to picking up off-odors. The plant should check to be sure excess blood, blood clots, and bone chips are removed. The plant should be especially concerned when heart meat is used. Frequently, the bone in the beef heart is not removed.

Another factor to be aware of is proper identification of meat, meat byproducts and poultry throughout the formulation process. Once a meat or poultry item has been chopped or ground, it loses its identity, making it nearly impossible to identify by sight.

A fairly good example of this is hydroflaking frozen mutton. It is very difficult to discern the difference between hydroflaked mutton and hydroflaked beef. There is a lot of difference, though. The plant is responsible for ensuring that one type of meat or poultry is not substituted for another type. Not only would the label be in error, but also the consumer would be receiving product containing meat or poultry ingredients that were not consistent with the label. Because some meats and meat byproducts and poultry are less expensive than others are, there is always a possibility that meat or poultry items might be purposely substituted. Since mutton resembles beef, the plant may consider keeping a running inventory of all mutton to help control accidental or intentional substitution. Identification of all ingredients from the first grinding through batching, stuffing, cooking, chilling, and any other process until the product is properly labeled in final stage, is of utmost importance.

Partially defatted beef or pork fatty tissue is considered a byproduct when added to cooked sausage products such as frankfurters and bologna. Partially defatted tissue is the result of low-temperature rendering of wholesome fat from boning and trimming lines.

Fat is rendered to a temperature not to exceed 120ºF and the protein is extracted from the fat, resulting in an emulsion-like product. This partially defatted product may be used in products identified is §319.180(b) at a level of 15 % or less of the meat, and meat byproducts, poultry or poultry and poultry byproducts (meat block) portion of the formula. A statement indicating “variety meats” or “ byproducts” must be added to the label contiguous to the product name. In addition, the ingredients statement would have to reflect these byproducts by name in descending order of predominance.

Another product, referred to as cured trimmings (not cooked/smoked), may be used as an ingredient in sausage products. Cured trimmings are sometimes referred to as “byproducts of the industry.” It is required that the ingredients statement be accurate for that product to which the trimmings are added. Most frequently, these trimmings are the result of trimming cured hams, picnics, and bellies prior to their being smoked and/or cooked. Usually these types of products have been cured with a pickle solution containing water, phosphate, nitrite, and other ingredients.

Cured trimmings must be listed in the ingredients statement. This can be done as a component, which means that the weight of the ingredients of cured trimmings will be added to the weights of similar ingredients in the formula, which could change the order of predominance. This is the case no matter what the percent of cured trimmings added. The other alternative is to list the trimmings in the proper order of predominance, then immediately following the word “trimmings,” list the ingredient statement for them parenthetically. For example, “…Cured pork trimmings (pork, water, salt, sodium nitrite,

sodium erythorbate)" is listed as a composite. (See Policy Memo 072.)

Bacon may be used in those cooked products identified in §319.180, such as franks, bologna, etc., provided the bacon is restricted to 10% of the meat block. Bacon used in other cooked sausages can be used in any amount. In the ingredients statement, bacon can be listed either as a composite or a component, regardless of the product to which it is added. If bacon from various sources is used, minor ingredients (less than 2% by weight at formulation) may be listed at the end of the composite or component as either " and/or" or "may contain."

REWORK

At one time or another the packer may want to use product referred to as "rework." Rework product is defined as product that has partially or fully completed the processing cycle. There are several reasons rework product occurs, but two are most common. During the cooking or smoking cycle, casings may "split," making the product unsaleable. There is also the "returned goods" aspect of rework. Needless to say, after reinspection of any returned or damaged product, the product that is still wholesome can be used as food. The packer may place this rework product back into "like" product. For example, if a stick of bologna splits during the cooking cycle, the packer may remove the casing and add the bologna to another chopper of bologna product. The most important consideration that the plant should be concerned with, other than wholesomeness, is that the rework product not be used in a product that has a different list of ingredients. There is no limitation on the amount of rework that can be added to a new product; however, the packer will usually restrict the amount used to 10% or less, because the quality of the new product could be lessened if too much rework were added. Rework has no binding capabilities.

In some cases, the packer will elect to add rework to an inferior formula with like or similar ingredients. This use of rework would also be acceptable provided the ingredients statement would not change. Rework cannot be listed as a composite. If additional ingredients are in the rework and not in the standard formulation, those additional ingredients must be listed in proper order of predominance on the finished product label. These additional ingredients will more than likely be listed in the "less than 2%" section of the ingredients statement. The term "rework" *does not* include uncooked cured trimmings or bacon ends and pieces. With the exception of products in edible collagen casings and casings from hog or sheep rounds, all casings must be removed from rework before regrinding or chopping. Excess ends of collagen casings must be removed.

All rework products should bear proper identification throughout the formulation cycle, specifying the type of product and ingredients. For the purpose of calculating restricted ingredients, you must not include rework product weights. This rework

product has already met the requirements for restricted amounts at the time of its formulation, and actually is being used as a filler.

CASINGS

There are three basic types of casings used to stuff meat and poultry sausages. Each type has certain advantages and disadvantages.

The *natural* casing is an animal casing. It is derived from various sections of viscera and must be inspected for condition, nodules, etc. It must also be thoroughly flushed and rinsed throughout its entire length before being stuffed. The natural casings most often used are those from the "rounds" of hogs and sheep. The term "rounds" refers to the small intestines. The plant may also use rounds from cattle and calves. "Middles" are derived from the large intestines of cattle and hogs.

Another source of natural casing is the "bung," which comes from the cecum, or blind gut of cattle. Bladders are also used for products such as headcheese and mortadella. Hog stomachs may also be used as containers for food products.

Some advantages of natural casings are:

1) they tend to be elastic, shrinking with the product as it is cooked;
2) they're digestible and therefore do not have to be removed before the product stuffed into them is consumed; and
3) they're permeable to smoke and moisture.

However, there are several disadvantages.

1) They're difficult to clean properly, which can make them expensive to prepare. Natural casings must be flushed before being used, though some animal casings are brought into the plant labeled "preflushed." These casings are generally packed in salt or salt and glycerin solution and only need to be rinsed before being used. Materials such as antibiotics, antioxidants, preservatives, nitrites, and nitrates are not permitted in preflushed casings.
2) They're seldom uniform in size throughout, which makes it difficult to predetermine the accurate weight of individual sausages.
3) With the exception of hog and sheep rounds, all natural casings must also be removed before the product stuffed into them can be used for rework.
4) Storage is also a problem, because they must be refrigerated.
5) They're not strong, which can result in "blowouts."

A second type of casing used today is the artificial casing.

1) It is generally strong, uniform in size, and easy to handle.
2) It can be stored in a dry non-refrigerated area.
3) It is permeable to smoke and moisture.
4) It can be purchased in just about any size or shape that the plant desires.

The majority of artificial casings are one of three types: *fibrous*, which is

made of special paper impregnated with cellulose and which can be purchased impermeable to moisture; *saran*, made of synthetic resins (plastics) that can be modified by the addition of harmless chemicals; or *hydrocellulose*, made from regenerated cellulose. The cellulose is obtained mostly from wood pulp and cotton linters (short fibers that adhere to cottonseed after the first ginning).

The most obvious disadvantage of an artificial casing is its indigestibility—it must be removed before product consumption.

The *collagen* casing is the last major type of casing and combines good features of both natural and artificial casings. Rework of product stuffed in edible collagen casings may be used in the production of emulsion-type sausage without removing the casing since collagen is a natural constituent of meat. Collagen is the major fibrous element of the connective tissue and is widely distributed in skin, bone, tendon, and arterial walls.

Stuffing product into any type of casing can be done in a number of ways. The plant may use automatic stuffers (air or water piston types, or open hopper pump types). They may stuff by hand or from a screw feed.

Some machines, such as the frankomatic, may contain a system designed to spray a vinegar solution, citric acid, or artificial smoke on the outer surface of the stuffed casing as a means of aiding peelability after cooking or to impart flavor.

COOKING AND/OR SMOKING

The smoking and cooking of any sausage product requires a working knowledge of the smoke-generating equipment, the method of heat application, and, in general, the cooking procedures for each type of product. Nonresinous woods are generally acceptable for smoking. Hardwood, hardwood sawdust, corncobs, corncob meal, redwood, redwood sawdust, mesquite wood, and mesquite sawdust are acceptable. If a product were labeled “hickory-smoked,” the plant must provide an appropriate certification that the sawdust or wood used for smoking is 100% hickory.

The cooking and smoking of sausage products accomplishes several things:

- As previously mentioned, heat is one of the three ways in which trichinae can be destroyed. (At a minimum, the internal temperature of pork muscle must reach 144^{o} F.)
- Heat and smoke tends to destroy and/or inhibit some bacteria responsible for spoilage and increases the shelf life of the product.
- Smoke enhances flavor and color.
- The heat and smoke are used to cook some products for ready consumption (ready-to-eat).

There are several factors the inspection program employee must be aware of when determining whether or not a product has been given the proper degree of cook and/or smoke. The fact that a product has reached its

required internal temperature may be only one necessary requirement. There are times when a specific percent or amount of shrink is required. The humidity must also be observed carefully to provide for adequate shrink.

The usual procedure for smoking product is to rapidly raise the temperature to between 110EF–120EF. During this first heating period, smoke is applied for a characteristic flavor and color. This time period will vary depending on the type of product, type of casing, etc. Then the temperature is increased to complete the heating cycle.

Smokehouses may have what is referred to as “cold spots.” The inspection program employee should be familiar with the smokehouse to determine the location of such cold spots so that when he or she checks the internal temperature of a product, if the temperature at the cold spot is acceptable, he or she can be fairly certain the rest of the product will have an internal temperature equivalent to or above the measured temperature.

Thermocouples may be used to record temperatures. They must be checked for accuracy and have ample prongs placed throughout the cooking unit to record the overall temperature.

Another method of cooking that warrants mention is baking. A baked product must be subjected directly to dry heat for enough time to permit the surface fat to be rendered and a brown crust to form on the product surface, and to allow sugar, if it is applied to the product surface, to be caramelized.

Baked loaves must be heated to an internal temperature of at least 160ºF.

CHILLING

Sausage products are usually showered with cold water in the smokehouse or oven to rapidly lower the product temperature to between 80ºF-95ºF. Showering helps prevent wrinkling of smaller sausage products. Chilling usually continues and the product is not packed for shipment before its internal temperature reaches 40ºF.

SUPPLEMENT

Title: Sausage Formulation Calculations

Resources: MPI Regulations
FSIS Directive 7620.3—Processing Inspectors' Calculations

Sections:

1. 70/30 Labeling Provision
2. Addition of Poultry Products to Cooked Sausage Products
3. Addition of Binders to Cooked Sausage Products
4. Calculated Finished Weight
5. Miscellaneous Calculations
    - Addition of Bacon and/or Bacon Ends and Pieces to Cooked Sausage
    - Addition of Partially Defatted Tissue to Cooked Sausage
    - Minimum liver Requirements in Certain Cooked Sausage
6. Calculate the Percent of Proteinaceous Ingredients in Cooked Sausage for Laboratory Determination of Added Water.

Purpose: These calculations will give the student sufficient background to accurately determine the compliance of various ingredients when he/she is given sample formulas.

NOTE: For the purpose of these Supplement problems, an answer to 2 decimal points will be acceptable.

Do not round up when calculating restricted ingredient amounts.

70/30 LABELLING PROVISION

How many times have you looked at a cooked sausage label and found the first two ingredients listed as “Beef and Pork” rather than “Beef, Pork”? The listing of two meat ingredients without a comma, even if they are not equal in percent, is acceptable under certain circumstances. For example, the label may say “Beef and Pork” but on any given day “Pork” may be present in greater amounts. How can this be?

FSIS Regulation §317.2 (f)(1)(v) says: “ When two meat ingredients comprise at least 70% of the meat and meat byproduct ingredients of a formula and when neither of the two meat ingredients is less than 30% by weight of the total meat and meat byproducts used, such meat ingredients may be interchanged in the formula without a change being made in the ingredients statement on labeling materials: provided, that the word “and “ in lieu of a comma shall be shown between the declaration of such meat ingredients in the statement of ingredients.

Why? For years, the availability of meat ingredients has fluctuated almost daily. Usually when the supply of beef is up, its price is down, and conversely when the supply is down its price is up. This same thing happens with pork and of course other sources of meat. The industry, knowing this, requested the department to allow them to manufacture cooked sausage products (with formulas utilizing two or more meats) by adjusting the percentage of meat ingredients according to availability, yet using the same label.

This all boils down to the fact that when two meat ingredients are connected by word "and," they can be interchanged provided they meet the regulation restrictions. These restrictions are:

- *Both* meat ingredients must account for at least 70% of the *total* meat and meat byproduct ingredients in the formula.
- The lesser of the two ingredients must consist of at least 30% of the *total* meat and meat byproduct ingredients in the formula.

More recently, to achieve harmony between the meat products inspection regulations and the poultry products inspection regulations, the poultry products inspection regulations were amended to allow establishments to interchange the identity of two kinds of poultry (chicken and turkey or chicken meat or turkey meat) used in a product formulation without changing the product’s ingredient statement or product name.

FSIS Regulation §381.118(f)(1)(i and ii) says: “The two kinds of poultry used must comprise at least 70% by weight of the poultry and the poultry ingredients

[e.g., giblets, skin or fat in excess of natural proportions, or mechanically separated (kind) used] and neither of the two kinds of poultry used can be less than 30% by weight of the total poultry and poultry ingredients used". The word "and" in lieu of a comma must be shown between the declaration of the two kinds of poultry in the ingredients statement and in the product name.

Let's see how you would go about checking to see if a typical formula would meet the 70/30 criteria. Here is a typical label.

Frankfurters

INGREDIENTS: Beef and pork, beef tripe, pork fat, water, salt, flavorings, sodium nitrite.

The batch formula reads:

Beef	125 lb
Pork	275 lb
Beef tripe	50 lb
Pork fat	50 lb
Water	5 lb
Salt	4 lb
Sodium nitrite	1.25 oz

The first thing you should do is to determine the *total* weight of the meat and meat byproduct (M/MBP) portion of the formula.

Beef	125 lb
Pork	275 lb
Beef tripe	50 lb
Pork fat	50 lb
	500 lb

Calculate to determine if *both* meats connected by the word "and" equal or exceed 70% (0.70) of the total M/MBP (meat block).

500 lb M/MBP x 0.70 = **350 lb**

Based on this calculation, the two main ingredients (in this case, beef and pork) must be at least 350 lb. Is this true? Let's check:

125 lb beef + 275 lb pork = **400 lb**

Since only 350 lb were needed to satisfy the requirement, the total of the two main ingredients is at least 70% of the total M/MBP (meat block).

Now look at the other criterion, which says: "Neither of these two main ingredients (beef and pork) can be less than 30% (0.30) by weight of the total M/MBP (meat block) used."

500 lb M/MBP x 0.30 = **150 lb**

Based on this calculation, the beef ingredient must equal at least 150 lb. Since 125 lb beef was used, the lesser meat ingredient **does not** equal or exceed 30% of the total M/MBP (meat block) and this formula does not qualify.

Both criteria must be met!

Answer the following questions:

Example 1

Franks, with Variety Meats Added

INGREDIENTS: Beef and pork, veal, water, pork stomachs, salt, flavorings, sodium nitrite.

Beef	285 lb
Pork	190 lb
Veal	75 lb
Water	70 lb
Pork fat	50 lb
Pork stomachs	25 lb
Salt	6 lb
Flavorings	3 lb
Sodium nitrite	1.5 oz

The total weight of the meat and meat byproducts (meat block) is? _____

The total weight of the meat ingredients connected by the word "and" is? _____

70% of the total meat and meat byproducts (meat block) is? _____

30% of the total meat and meat byproducts (meat block) is? _____

Would you allow the plant to interchange these two meat ingredients (beef and pork) and use the same label without any adjustment? YES NO

If you answered NO, was your reason that

A. The 70% provision is not in compliance?
B. The 30% provision is not in compliance? A B

Example 2

Bologna

INGREDIENTS: beef and pork, water, salt, flavorings, sodium nitrite.

Pork	105 lb
Beef	75 lb
Water	25 lb
Salt	4 lb
Flavoring	1.5 lb
Sodium nitrite	0.45 oz

Would you allow the plant to interchange these two meat Ingredients (beef and pork) and use the same label without any adjustment?

YES NO

If you answered NO, was your reason that

A. The 70% provision is not in compliance?
B. The 30% provision is not in compliance? A B

Example 3

Frankfurters with Variety Meats Added

INGREDIENTS: Beef and pork, pork fat, beef lips, water, salt, flavorings, sodium nitride.

Beef	200	lb
Pork	150	lb
Pork fat	100	lb
Beef lips	50	lb
Water	50	lb
Salt	5	lb
Flavorings	3	lb
Sodium nitrite	1.25	oz

Would you allow the plant to interchange these two meat Ingredients (beef and pork) and use the same label without any adjustment?

YES NO

If you answered NO, was your reason that

A. The 70% provision is not in compliance?
B. The 30% provision is not in compliance? A B

ADDITION OF POULTRY PRODUCTS TO COOKED SAUSAGE PRODUCTS

Cooked sausage products identified in §319.180 of the MPI Regulations may contain poultry products that, individually or in combination, are not in excess of 15% of the *total* ingredients, excluding water. [§319.180(a)(b)]

Before we get into determining the allowed amounts of poultry, it might be a good idea to identify, which poultry products are allowed and which are not. For example, these sausage products *cannot* contain the following poultry items:

- Kidneys
- Sex glands

They *can* contain the following poultry products:

- Poultry meat and/or poultry (raw/cooked)
- Poultry gizzards or poultry hearts [§381.1(c)]
- Either chicken or turkey
- Comminuted poultry if labeled "Kidneys and Sex Glands Removed" [§319.180(b)]

For the purpose of clarification, review the following definitions. The term "poultry products" includes:

- Poultry meat [§319.180(g)]
  Deboned chicken or turkey meat, *without* skin or *added* fat

- Chicken or turkey [§381.118]
  Includes edible parts such as skin and fat when not in excess of their natural proportions

- Poultry byproducts [§381.1(c)]
  Skin, fat, gizzard, heart, and liver.

For the purpose of labeling, *all* poultry must be declared in the ingredients statement. Examples of acceptable terminology; chicken meat, turkey meat, chicken, turkey, chicken gizzards, chicken hearts, turkey gizzards, turkey hearts.

To determine the maximum amount of poultry in a cooked sausage product (such as frankfurters), proceed as follows:

The *total batch* weight excluding water may contain 15% poultry products. For example:

The establishment formulates a 650 lb batch of franks containing variety meats, 110 lb of water, and 70 lb of chicken gizzards. Are the gizzards in compliance?

For the purpose of calculation you would remove the water, leaving 540 lb, which includes the chicken gizzards.

650 lb (batch weight) - 110 lb (water) = **540 lb** (batch weight excluding water)

At this point you do not know whether or not the 70 lb of chicken gizzards are in compliance, so removed them.

540 lb (weight excluding water) - 70 lb (gizzards) = **470 lb** (excluding water & gizzards)

Now you have 470 lb of the batch weight remaining. For the purpose of calculating poultry product restrictions only, the 470 lb represents 85% of the batch. Any time you divide a figure by its represented percentage, the result will be 100%.

470 ÷ 0.85 (i.e., 85%) = **552.94 lb**

552.94 lb is the batch weight including the maximum amount of gizzards allowed (but excluding water). Subtract the 470 lb (85%) from 552.94 lb to determine the maximum amount of chicken gizzards.

552.94 - 470.00 = **82.94 lb**

In this batch/formula, the plant could have used a maximum of 82.94 lb of chicken gizzards. Since they were only using 70 lb, the formula *is* in compliance with poultry restrictions.

Review the preceding before you calculate the following problems.

Example 1

Establishment 38 is formulation a bologna product with a batch size of 425 lb. The formula calls for 68 lb of water and 65 lb of chicken meat.

The maximum amount of chicken meat permitted is:

(a) 343.52 lb (b) 51.52 lb (c) 43.8 lb

Is the amount of chicken meat in this batch in compliance?

YES NO

Show your calculation below.

Example 2

Establishment 38 formulates a ring bologna product. The total batch weight is 350 lb and includes 52.5 lb of water and 44.6 lb of deboned turkey meat.

The maximum amount of turkey allowed is?

_____

Is the amount of turkey used in this formula within compliance?

YES NO

Show your calculations below.

ADDITION OF BINDERS IN COOKED SAUSAGE PRODUCTS

There are several binders approved for use in cooked sausage products [§319.180(e), §319.140, and §318.7(c)]. These binders are limited to 3.5% (individually or collectively) in the finished weight of the product, except that 2% of isolation soy protein (ISP) is deemed to be equivalent to any one or more of these binders.

Sample Problem 1

A cooked sausage product contains 17 lb nonfat dry milk (NFDM) and has a finished weight of 500 lb. Determine the maximum amount of NFDM allowed.

Formula—Multiply the finished product weight times the percentage of NFDM allowed.

500 lb (weight) X 0.035 (i.e., 3.5%, maximum NFDM % = **17.5 lb**

In this formula, 17.5 lb of NFDM is the maximum amount allowed.

Sample Problem 2

A cooked sausage product contains 10 lb ISP and has a finished product weight of 500 lb. Determine the maximum amount of ISP allowed.

Formula—Multiply the finished product weight times the percentage of ISP allowed.

500 lb (weight) X 0.02 (i.e., 2%, maximum ISP%) = **10 lb**

In this formula, 10 lb of ISP is the maximum amount allowed.

When ISP or sodium caseinate is used in combination with other binders, a conversion ratio must be calculated. The Regulations state that 2% ISP or 2% sodium caseinate is equivalent to 3.5% of other binders. This is a ratio of 2% to 3.5%, which can also be expressed as:

2% ÷ 3.5%

By dropping the percentage signs and dividing the numerator by the denominator, you obtain a constant, 0.57. This means that 2% is a little more than one-half of 3.5%.

2 ÷ 3.5 = **0.57**
Conversely, by reversing the two figures and dividing, you obtain a constant of 1.75. This means that 3.5% is almost two times 2%.

3.5 ÷ 2 = **1.75**

Therefore, when converting ISP to binders, multiply the ISP times the constant 1.75. [When converting from a smaller amount (2%) to a larger amount (3.5%), multiply by the constant that is greater than 1.]

10 lb (ISP) X 1.75 (Constant) = **17.5 lb** (e.g., NFDM)

10 lb of ISP is equivalent to 17.5 lb NFDM.

When converting other binders to ISP, multiply the binder times the constant 0.57. [When converting from a larger amount (3.5%) to a smaller amount (2%), multiply by the constant that is less than 1.]

15 lb (e.g., NFDM) X 0.57 (constant) = **8.55 lb** (ISP)

15 lb NFDM is equivalent to 8.55 lb ISP.

Sample problem 3

A cooked sausage product contains 4 lb NFDM and 2 lb ISP, with a finished weight of 250 lb. Are the amounts of NFDM and ISP in compliance?

Note: Any approved binder could be used. This formula contains NFDM.

Determine the maximum amount of ISP allowed in combination with 4 lb NFDM.

First, determine the maximum amount of NFDM allowed. (See sample problem 1.)

250 lb (weight) X 0.035 (maximum NFDM %) = **8.75 lb** ((NFDM allowed)

Subtract the NFDM used in this formula from the maximum amount of NFDM allowed.

8.75 lb (NFDM allowed) - 4.00 lb (NFDM used) = **4.75 lb** (NFDM not used)

Convert the amount of NFDM not used in the formula to ISP by multiplying by the constant 0.57. The result will be the amount of ISP that is equivalent to the amount of NFDM not used.

4.75 lb (NFDM not used) X 0.57 (constant) = **2.7 lb** (ISP allowed)

The maximum amount of ISP allowed is 2.7 lb. Since the product contains only 2 lb of ISP, it is in compliance.

Example 1

A cooked sausage contains 5 lb ISP and 5 lb calcium-reduced dried skim milk (CRDSM). The finished weight of this sausage product is 400 lb. Determine the maximum amount of CRDSM allowed in combination with 5 lb ISP.

The maximum amount of ISP allowed is? _____

The conversion constant used in this problem is? _____

The maximum amount of CRDSM allowed in this product is? _____

Show your calculations below.

DETERMINING THE THEORETICAL OR "CALCULATED" FINISHED WEIGHT

This section will discuss the method used to determine a "calculated" finished weight (CFW) for cooked sausage products. Read and study pages 100-102 of FSIS Directive 7620.3, the Processing Inspectors' Calculations Handbook.

Cooked sausage products identified in §319.140 are limited to 10% added water, e.g., Polish sausage, cooked salami, liver sausage.

Cooked sausage products identified in §319.180 are limited to 30% total fat or a total of 40% fat plus added water, e.g., frankfurters, bologna, knockwurst.

A plant may target for 15% water and 25% fat, or *any* combination of fat plus added water that equals 40%.

There is a method identified in the Processing Inspectors' Calculations Handbook to calculate a product's finished weight. Let's call this the "calculated" finished weight (CFW). The CFW *always* includes the **maximum** targeted water. Once you determine a CFW, you can use the weight to calculate the maximum amount of binders and extenders allowed in each formula.

Suppose the establishment had the following formula on file. You could calculate a finished weight and make an estimation of compliance for the binders and extenders. Is the amount of nonfat dry milk (NFDM) they intend to use in compliance?

Beef	250 lb
Pork	250 lb
Water and ice	70 lb
Rework (like product)	50 lb
NFDM	18 lb
Salt	5 lb
Flavorings	4 lb
Sodium erythorbate	4 3/4 oz
Sodium nitrite	11/4 oz
Batch weight total	**648 lb**

(Finished Product Target = 10% Water and 30% Fat).

Always remove rework weights from the formula total. (This is true for *all* calculations.)

648 lb - 50 lb (rework) = **598 lb**

598 lb is now considered 100% of the batch total. To determine the calculated finished weight, always subtract the *weight and percentage* of added water and the restricted ingredient(s) that have limits based on the CFW from the batch weight.

598 lb - 70 lb (water) = **528 lb** (90% batch weight, i.e., 100% -10% max water)

528 lb - 18 lb (NFDM) = **510 lb** (86.5% batch weight, i.e., 90% - 3.5% max NFDM)

Therefore 510 lb is actually 86.5% of this formula. To determine 100% of the formula, divide the portion (510 lb) by its percent (86.5%).

510 ÷ 0.865 (i.e., 86.5%) = **589.59 lb CFW**

This represents the calculated finished weight of this formula, including a maximum 10% added water and a maximum 3.5% NFDM.

Now merely multiply the CFW by 3.5% to determine the maximum amount of NFDM allowed.

589.59 X 0.035 (i.e., 3.5%) = **20.63 lb** (NFDM allowed).

In this formula, the amount of NFDM used (18 lb) is less then the maximum amount allowed (20.63 lb); therefore, we would accept the NFDM as being in compliance.

Another formula, using cereal.

Beef	275 lb
Pork	125 lb
Water and ice	93 lb
Chicken gizzards	27 lb
Rework	40 lb
Cereal	21 lb
Corn syrup	13 lb
Salt	8 lb
Seasonings	4 lb 12 oz
Ascorbic acid	3 oz
Sodium nitrite	1 oz
Total batch	**607 lb**

(Finished Product Target = 15% Water - 25% Fat)

607 lb - 40 lb (rework) = **567 lb** (100% batch weight)

Corn syrup consists of 20% water and 80% solids. Therefore, you must calculate the amount of water being added to the formula through use of corn syrup. This amount must be added to the total amount of water removed.

13 lb × .20 (20%) = 2.6 lb water 2.6 lb + 93 lb = 95.6 lb water

567 lb - 95.6 lb (water) = **471.4 lb** (85% batch weight, i.e., 100% - 15% max water)

471.4 lb - 21 lb (cereal) = **450.4 lb** (81.5% batch weight, i.e., 85%- 3.5% max cereal)

450.4 lb ÷ 0.815 (i.e., 81.5%) = **552.63** (CFW)

Answer the following questions.

The maximum amount of cereal allowed in this formula is?

(a) 19.34 lb (b) 21.00 lb (c) 21.24 lb

Is this amount of cereal used in the formula in compliance?

YES NO

Example 1

Frankfurters with Variety Meats

Beef	150 lb	
Pork	150 lb	
Beef tripe	100 lb	
Water	70 lb	
Rework (like Product)	40 lb	
NFDM	11 lb	
Corn syrup solids	10 lb	
Salt	4 lb	
ISP	3 lb	
Flavorings	3 lb	12 oz
Sodium ascorbate		3 oz
Sodium nitrite		1 oz
TOTAL	**542 lb**	

Finished Product Target = 10% Water - 30% Fat.

Answer the following questions. Show calculations below.

What is the CFW? _____

How much ISP is allowed in combination with the NFDM? _____

MISCELLANEOUS CALCULATIONS

- The addition of bacon ends and pieces to a cooked sausage— 10% limitation.
- The addition of partially defatted beef and/or pork fatty tissue—15% limitation.
- The addition of fresh liver to sausage products that require a *minimum* amount of liver by Regulation—30%

Bacon and/or bacon ends and pieces may be added to the cooked sausage products covered by §319.180 of the Regulations. The addition of bacon is limited to 10% of the meat and/or meat byproducts and poultry products (meat block) in the formula. (Food Standards & Labeling Policy Book)

Sample Problem 1

Bologna with Variety Meats

Beef	150 lb
Pork	100 lb
Pork stomachs	50 lb
Poultry gizzards	50 lb
Bacon ends and pieces	40 lb .
TOTAL M/MBP	**390 lb**

Determine the maximum amount of bacon ends and pieces allowed. After totaling all meat/meat byproducts (390 lb), subtract the ingredient in question (bacon ends and pieces) from the total M/MBP.

390 lb – 40 lb = **350 lb** (90% M/MBP, i.e., 100% - 10% max bacon ends and pieces)

Divide 350 lb by 90%.

350 lb ÷ 0.90 (i.e., 90%) = **388.88 lb** (M/MBP including maximum bacon ends and pieces)

Subtract 350 lb (90%) from 388.88 lb (100 %)

388.88 lb – 350 lb = **38.88 lb**

A maximum of 38.88 lb bacon ends and pieces is allowed in this bologna formula.

Example 1

Frankfurters with Variety Meats

Pork	220 lb
Veal	75 lb
Beef trimmings	75 lb
Partially defatted beef fatty tissue	60 lb
Chicken hearts	35 lb

Note: Use the same method for calculation described on the previous page. If the formula listed partially defatted chopped beef or chopped pork, you would use the same method to determine the maximum amount allowed.

The maximum amount of partially defatted beef fatty tissue is?

(a) 46.5 lb (b) 37 lb (c) 45 lb (d) 71.74 lb

Show your calculations below.

Example 2

Braunschweiger

Skinless pork jowls	150 lb
Pork stomachs	100 lb
Pork livers	100 lb
Water	35 lb
Flavorings	4 lb
Monosodium glutamate	15.2 oz
Sodium nitrite	0.8 oz
TOTAL	**390 lb**

Note: The same method of calculation is used as previously shown except that the determination of liver is based on *total* batch weight. §319.182 requires 30% liver in *total* batch.

The minimum amount of liver required is:

(a) 117.18 lb (b) 124.28 lb (c) 100 lb

Show your calculations below.

CALCULTING THE PERCENT OF PROTEINACEOUS INGREDIENTS IN COOKED SAUSAGE FOR LABORATORY DETERMINATION OF ADDED WATER

Water naturally contained in meat, meat byproducts, mechanically separated (species), or poultry ingredients is not considered as added water but as water indigenous to livestock or poultry. Slaughtered livestock or poultry ingredients have a consistent moisture-to-protein ratio of approximately 4 to 1. This means that for each percent of meat/poultry protein the normal amount of water should be 4 percent. For products with a water limitation, the laboratory uses this moisture-to-protein ratio to determine added water. When the laboratory runs an analysis it will determine the total protein in the product. Protein content is determined by measuring the amount of nitrogen present in a sample of product and making appropriate calculations. Therefore, when proteinaceous or nitrogenous substances from plant products, egg products, milk products, yeast products, or their derivatives, or from slaughtered livestock or poultry that have been processed by such means as hydrolysis, extraction, concentrating, or drying, are added to cooked sausages, they must be deducted from the total analytical protein to determine the amount of slaughtered livestock or poultry protein present and to determine what proportion of water present in the product is attributable to these slaughtered livestock or poultry ingredients. This calculation is easily accomplished if the laboratory knows the amount of nonmeat protein or other nitrogenous substances that have been added so that it can be deducted from the total protein content of the finished product. Hence, when a cooked sausage product is sampled, the program employee must calculate the percent of proteinaceous additives (classified as Group 2 Protein in §318.22 of MPI Regulations) in the finished product. This is indicated on FSIS Form 10,600-1. FSIS permits one percent of the formula weight of certain ingredients *not* considered as proteins of slaughtered livestock or poultry origin to be considered as protein when calculating added water. If the program employee has indicated the percent protein of ingredients not of slaughtered livestock or poultry origin, then the laboratory can make the adjustment to the total protein in order to determine the meat protein in the sample.

CALCULATION OF PERCENT OF GROUP 2 PROTEIN IN COOKED SAUSAGES

The Program employee will calculate the percent of Group 2 Protein in cooked sausages on a *per batch* basis in the following manner:

- Step 1. Total the weight of all Group 1 Protein contributing ingredients, e.g., meat, meat byproducts, poultry products, and mechanically separated (species). Do not include ingredients of slaughtered livestock or poultry origin processed by hydrolysis, extraction, concentrating, or drying.

- Step 2. Total weight of solids contributed by all other ingredients.

- Step 3. Calculate the pounds of finished cooked sausage per batch by adding the total weights of Steps 1 and 2 and dividing this total by 100 minus the percent of permitted added water.

- Step 4. Total the weight of all protein contained in Group 2 protein contributing ingredients, e.g., slaughtered livestock or poultry ingredients that have been processed by hydrolysis, extraction, concentrating, or drying and other ingredient that contributes protein.

- Step 5. Divide the total of step 4 by the total of Step 3 times 100 to determine the percent of Group 2 Protein in cooked sausage that must be identified on FSIS Form 10,600-1.

Example:

Establishment 38 is formulating a bologna product with a batch size of 580 lb. The formula calls for 450 lb of meat and meat byproducts, and 48 lb of solids from all other ingredients. The solids portion of the formula includes 15 lb of soy protein concentrate (70% protein by label declaration) and 5 lb of mustard flour (30% protein by label declaration). What percent of Group 2 Protein contributing ingredients *must* be identified on FSIS Form 10,600-1?

At this point you know that 450 lb represents the amount of Group 1 ingredients and that 48 lb represents the amount of solids of all other ingredients in this batch.

To determine the total pounds of finished cooked sausage with a 10 percent added water limitation, *add* the total weight of Group 1 ingredients and the total weight of solids of all other ingredients, and then *divide* this total by 100 minus the percent of permitted “added water.” In this example:

450 lb (Group 1 Ingredients)
\+ 48 lb (Solids of All Other Ingredients)
498 lb (Total)

$$\frac{\text{498 lb (Total of Group 1 Ingredients/Solids of All Other Ingredients)}}{\text{.90 (90\% = 100\% - 10\% Water Limitation)}} = \text{553.3 lb (Total Pounds Finished Cooked Sausage)}$$

To determine the total pounds of protein contributed from Group2 Protein ingredients, *multiply* each Group 2 ingredient or mixture containing one or more Group 2 Ingredients by its percent protein, and then *add* the results for a total protein weight. In this example:

- Calculate the amount of protein in the Soy Protein concentrate.

  15 lb (Amount of Soy Protein Concentrate Used)
  X .70 (Amount of Protein in the Soy Protein Concentrate-"70%")
  10.5 lb (Amount of Protein in 15 lb of Soy Protein Concentrate)

- Calculate the amount of protein in the mustard flour.

  5 lb (Amount of Mustard Flour Used)
  X .30 (Amount of Protein in the mustard Flour –"30%")
  1.5 lb (Amount of Protein in 5 lb of Mustard Flour)

- Determine the total amount of protein.

  10.5 (Amount of Protein in 5 lb of Soy Protein Concentrate)
  \+ 1.5 (Amount of Protein in 5 lb of Mustard Flour)
  12 lb (Total Amount of Protein Contributed from Group 2 Protein Ingredients)

To determine the percent of Group 2 Protein in cooked bologna that must be indicated on FSIS Form 10,600-1, *divide* the total weight of the protein contributed from Group 2 protein ingredients by the total weight of finished cooked sausage times 100. For this example:

12 lb (Total Amount of Protein Contributed From Group 2 Protein Ingredients) / 553.3 lb (Total Pounds of Finished Cooked Sausage) x 100 = 2.17% (Percent Group 2 Protein in this batch)

For this batch of cooked bologna, you would identify 2.17% Group 2 Protein on FSIS Form 10,600-1.

The program employee may also calculate the percent of Group 2 Protein in cooked sausage on a *yield basis* in the following manner:

Step 1. Determine the total yield of the finished cooked sausage batch based on previous processing yields.

Step 2. Determine the total amount of Group 2 protein contributed by ingredients of the batch.

Step 3. Calculate the percent Group 2 protein in the finished product by dividing the weight in Step 2 by the weight in step1 and multiply by 100.

Example:

Establishment 38 produces a finished batch of franks weighing 637 lb. The formula for this batch of franks called for 10 lb of hydrolyzed corn protein (50% protein by label declaration) and 3.5 lb of monosodium glutamate (50% protein by label declaration). What percent of Group 2 protein contributing ingredients must be identified on FSIS Form 10,600-1?

At this point you know that 637 lb represents the total yield of the finished franks.

Next, to determine the total pounds of protein contributed from Group 2 Protein ingredients, multiply each Group 2 ingredient or mixture containing one or more Group 2 ingredients by its percent protein, and then add the results for a total protein weight. For this example:

- Calculate the amount of protein in the hydrolyzed corn protein.

  10 lb (Amount of Hydrolyzed Corn Protein Used)
  × .50 (Amount of Protein in the Hydrolyzed Corn Protein--50%)
  5 lb (Amount of Protein in the 10 lb of Hydrolyzed Corn Protein)

- Calculate the amount of protein in the monosodium glutamate.

  3.5 lb (Amount of Monosodium Glutamate Used)
  × .50 (Amount of Protein in the Monosodium Glutamate–50%)
  1.75 lb (Amount of Protein in 3.5 lb of Monosodium Glutamate)

- Determine the amount of Protein.

  5 lb (Amount of Protein in 10 lb of Hydrolyzed Corn Protein)
  × 1.75 lb (Amount of protein in 3.5 lb of Monosodium Glutamate)
  6.75 lb (Total Amount of Protein Contributed from Group 2 Proteins Ingredients)

- To determine the percent of Group 2 Protein in the cooked franks that must be indicated on FSIS Form 10,600-1, *divide* the total weight of *protein* contributed from Group 2 Protein ingredients by the total *yield* of finished franks, times 100. In this example:

$$\frac{\text{6.75 lb (Amount of Protein Contributed from Group 2 Protein Ingredients)}}{\text{637 lb (Total Yield of Finished Franks)}} \times 100 = 1.0596\%$$

(Percent of Group 2 Protein in the batch of Franks)

Round to two decimal places to ensure that all Group 2 Protein-contributing ingredients are taken into account for analysis purposes.

For this batch of franks, you would identify 1.06% Group 2 Protein on FSIS Form 10,600-1.

Work the following problem:

Establishment 38 is formulating beef wieners with a batch size of 767 lb. The formula calls for 600 lb of meat and meat by products, 10% added water, and 57 lb of solids from all other ingredients. The solids portion of the formula includes 15 lb of nonfat dry milk (35% protein by label declaration), 6 lb of isolated soy protein (90% by label declaration), and 12 lb of a proprietary mixture containing proteinaceous additives, e.g., milk protein hydrolyzate, autolyzed yeast, monosodium glutamate, and hydrolyzed wheat protein. The label on the proprietary mixture indicates that the mixture contains 65% protein. What percent of Group 2 Protein contributing ingredients must be identified on FSIS Form 10,600-1?

NOTE: If protein is added to product via proteinaceous additives without your knowledge, the product can be adulterated with water it will not show up in the analysis because the laboratory would not have made an adjustment. Remember, that each one-percent protein from proteinaceous additives not subtracted from the total protein content results in the addition of 4 percent added water in cooked sausages that is not detected in laboratory analysis.

Example of why it is important to record the protein from Group 2 Protein contributing ingredients on FSIS Form 10,600-1.

Beef Wieners (10% Water Added)
Laboratory Analyzes:

Total Water = 55%
Total Fat = 29.9%
Total Protein = 12%

Percent protein from Group Two Protein contributing ingredients indicated on FSIS Form 10,600-1 = 2.53%.

(**NOTE:** If the percent protein from Group 2 Protein contributing ingredients is one or less do not conduct steps 1 and 2.)

- Step 1. 2.53
  - 1.00 Subtract the one-percent allowed
  1.53

- Step 2. 12.00
  - 1.53 Subtract the remaining percent protein
  10.47 of Group 2 Protein contributing ingredients

- Step 3. 10.47
  X 4.00 Protein multiplier
  41.88% Indigenous water—water attributed by Group 1 Protein contributing ingredients and one percent of Group 2 Protein contributing ingredients.

Step 4. 55.00
- 41.88 Subtract indigenous water from total water
13.12% *Added water*

If the percent of protein from Group 2 Protein contributing ingredients had not been indicated on FSIS Form 10,600-1 the added water for this product would have been 7%.

- Step 3. 12.00
  X 4.00
  48.00%

- Step 4. 55.00
  - 48.00
  7.00%

COMPLETED EXAMPLE FSIS FORM 10,600-1 CHEMCIAL LABORATORY ANALYSIS

The response to this information collection is voluntary. The information is needed before approval is granted to laboratories analyzing meat and poultry samples. The information is used to assure product compliance (9CFR 318-21(b)) Form approved: 0583-8080 to assure product compliance (9CFR 318.21(b)).

To Be Completed by Inspector (Except 1 and 2)

1. INTERNAL LAB NO.	DOMESTIC CHEMICAL LABORATORY REPORT			
	2. TYPE SAMPLE	NUMERIC CODES: 3. STATE / 4. REGION / 5. AREA	6. SERIAL NO.	
			844421	
7. DATE SAMPLED	8. DATE MAILED	9. TECHNICAL SUPPORT LAB		
Today's date		☐ EASTERN LAB ☐ WESTERN LAB ☐ MIDWESTERN LAB ☐ CONTRACT LAB NAME:		
10. RETAIN TAG NO	11. PRODUCT CODE 14	12. SPLIT SAMPLE NO.	13. ACCREDITED LAB NAME	14. ACCREDITED LAB NO.
15. EST. NO. 38	16. EST. NAME	17. STREET ADDRESS (*Include City, State, and Zip Code*)		

18. LABEL APPROVAL DECLORATION OF REGULATED PERCENT NON MEAT PROTEINACEOUS ADDITIVE IN FINISHED PRODUCT(*must be completed by inspector) (Non-meat proteinaceous additives used in PFF products and not listed below should be indicated in block 21.)*

a. N. F.D. MILK %	b. I. S. P. %	c. SOY PROTEIN CONCENTRATE %	d. SOY FLOWER %	e. H. V. P %	f. M.S.G. %	g. GELATIN %	h. OTHER NON-MEAT PROTEIN 2.8 %

19. SCHEDULED INSPECTION TASK NO. ➡ | 20. UNSCHEDULED INSPECTION TASK NO. ➡

21. NAME OF PRODUCT AS LABELED AND INGREDIENTS

Bologna with Variety Meats:
Ingredients: Beef and Pork, Water, Pork Fat, Corn Syrup, Salt, Spices, Sodium Nitrite.

22. INSPECTOR'S NAME	23. TELEPHONE NO.	24. SIGNATURE OF INSPECTOR

25. ANALYSIS REQUESTED AND FINDINGS (*Inspector check analysis requested*)

					INSPECTOR REQUESTED TEST	LABORATORY ENTER	
						TEST CODE	TEST RESULT
☐ TOT. PROTEIN 01 %	☐ MEAT PROTEIN 02/60 %	☐ TOTAL WATER 03 %	☐ ADDED WATER 04 %	☐ + ADD. SUBS 05 %			
☐ – ADD. SUBS 06 %	☐ SALT 07 %	X TOTAL FAT 08 %	☐ MAX. INT. TEMP 09 %	☐ SODIUM NITRITE 10 ppm			
☐ SODIUM NITRATE 11 %	☐ PHOSPHATE 12 %	☐ M/P RATIO 23	☐ BRINE CONTENT 24 %	☐ PERCENT BONE 26 %			
☐ FAT BY DIFFERENCE 30 %	☐ SULFITE 31 ppm	☐ ASCORBATE 34 ppm	☐ FAT + ADDED WATER 67 %	☐ CALCULATED PFF 68 %			

26. For laboratory use only *(Results, additional laboratory findings such as description of sample(s): reserve sample(s).*

To Be Completed by Laboratory

27. CONDITION CODES			28. LAB CODE	29. DATE RECEIVED	30. ANALYSIS DATES		31. SRC	32. WC
RECEIPT	SEAL	DISCARD			a. STARTED	b. COMPLETED		

33. SIGNATURE OF ANALYST(S)	34. ANALYST CODE (S)	35. REVIEWED BY (*SIGNATURE*)

FSIS FORM 10,600 - 1 (6/94) — COPY 1 - LABORATORY - Send to Inspector

36. INTERNAL LAB NO.	37. EST. NO.	38. PRODUCT NAME	39. SPLIT SAMPLE NO.	40. SERIAL NO. 844421

FSIS FORM 10,600 - 1 (6/94) — REPLACES FSIS FORM 10,600 -1 (11/89) WHICH IS OBSOLETE

TEAR STRIP 1: INSPECTOR ATTACH TO REGULATORY SAMPLE
(Inspector, include self-addressed envelope or label in plastic bag)

PROBLEMS

To complete each of the problems on the following pages, you should:

1. Answer each question on the blank page facing the problem.

2. Show all your calculations.

3. Utilize any material or information you have, such as:

    - Processing Inspectors' Calculations handbook.

    - The section in the module(s) that refers to any portion of the problem you are solving.

    - The FSIS regulations.

PROBLEM 1 (Cooked Sausage Product)

Beef (boneless cow meat)	150 lb
Beef Trimmings	100 lb
Pork Jowls (skinned)	50 lb
Cured Pork Trimmings (10% pump, no corn syrup)	50 lb
Water and Ice	120 lb
Pork Fat	76 lb
Bologna Rework (like product)	50 lb
Chicken	40 lb
Chicken Hearts	37 lb
Salt	13 lb
Corn Syrup Solids	11 lb 8 oz
Curing Mix (6.25% nitrite salt carrier)	1 lb 6 oz
Monosodium Glutamate (50% Protein)	10 oz
Sodium Erythorbate	5 oz
Paprika	3 oz
TOTAL Batch	**700 lb**

(Finished Product Target = 10% Water and 30% Fat)

Label— Bologna with variety Meats

INGREDIENTS: Beef and Pork, Water, Chicken, Corn Syrup, Flavorings, Sodium Erythorbate, Sodium Nitrate, Sodium Nitrite.

Answer the following questions.

1. Is the 70/30 rule in compliance?

2. Identify the items in the formula that are considered meats, meat byproducts, poultry, or poultry byproducts.

3. Is the curing agent and curing accelerator in compliance?

4. Are the poultry products listed in the formula (chicken and chicken hearts) in compliance?

5. Is the product name correct? If not, give the correct name.

6. Are the ingredients listed in proper order of descending predominance? If not, list them in proper order.

Use the next page to show your calculations.

PROBLEM 2 (Cooked Sausage Product)

Beef	100 lb
Beef Tripe	100 lb
Pork jowls (skinned)	100 lb
Pork Stomachs	100 lb
Bacon Ends and Pieces (pork, water, salt, sugar, sodium phosphate, sodium erythorbate, sodium nitrite)	50 lb
Rework (like Product)	50 lb
Ice	90 lb
Corn Syrup	11 lb
Isolated Soy Protein (90% Protein)	4 lb
Nonfat Dry Milk (35% Protein)	8 lb
Salt	5 ¾ lb
Flavorings	4 lb
Sodium Erythorbate	2 ¾ oz
Sodium Nitrite	1 ¼ oz
TOTAL	**623 lb**

(Finished Product Target = 15% Water and 25% fat)

Label—Frankfurters
Isolated Soy Protein and Nonfat Dry Milk Added

INGREDIENTS: Pork, Beef, Beef Tripe, Water, Corn Syrup, Isolated Soy Protein, Nonfat Dry Milk, Salt, Spices, Sodium Erythorbate, Sodium Nitrite.

Answer the following questions.

1. Is the use of bacon ends and pieces in compliance?

2. How much NFDM is allowed in combination with ISP?

3. Is the curing agent and curing accelerator in compliance?

   a. Nitrite b. Sodium Erythorbate

4. Give the required product name and ingredient statement for this formula.

Use the next page to show your calculations.

PROBLEM 3 (Cooked Sausage Product)

Beef	175 lb
Pork	125 lb
Partially Defatted Pork Fatty Tissue	60 lb
Pork Fat	25 lb
Water and Ice	90 lb
Salt	4 lb
Spice Mixture (4.5% Protein)	2 lb
Mustard Flour (29% Protein)	2 lb
Beef extract (100% Protein)	2 lb
Monosodium Glutamate (50% Protein)	2 lb
Sodium Erythorbate	7 ¼ oz
Sodium Nitrite	¾ oz
TOTAL	**487 lb 8 oz**

(Finished Product Target = 10% Water and 30% Fat)

Label— Joe's Quality Franks

INGREDIENTS: Beef, Pork, Water, Partially Defatted Pork Fatty Tissue, Pork Fat, Flavorings, Spices, Sodium Erythorbate, Sodium Nitrate, Sodium Nitrite.

Answer the following questions.

1. How many pounds of partially defatted pork fatty tissue are permitted in this formula?

2. Calculate percent of Group 2 Protein contributing ingredients that must be identified on FSIS Form 10,600-1.

3. List the product name and ingredients.

Use the next page to show your calculations.

PROBLEM 4 (Cooked Sausage Product)

Unskinned pork Jowls	160 lb
Beef Tripe	150 lb
Pork Livers	140 lb
Pork Fat	50 lb
Water	30 lb
Nonfat Dry Milk (35% Protein)	18 lb
Onions	16 lb
Salt	15 lb
Monosodium Glutamate (50% protein)	1 ½ lb
White Pepper	1 lb
Mace	11 oz
Marjoram	11 oz
Ground Cloves	2 ½ oz
Sodium Nitrite	2 ½ oz
TOTAL	**583 lb**

Label—Liver sausage
Nonfat Dry Milk Added

INGREDIENTS: Unskinned Pork Jowls, Beef Tripe, Pork Livers, Pork Fat, Water Nonfat Dry Milk, Onions, Salt, Spices, Monosodium Glutamate, Sodium Nitrite.

Note: For this problem ***only***, use the batch weight to determine NFDM compliance. It is normal for this type of product to have less than 10% added water in the formula (because it is cooked in a impervious casing, thus there isn't any cook shrink). If you were to calculate a CFW for this formula, the CFW would be greater than the batch weight.

Answer the following questions.

1. Identify the byproducts used in this formula.

2. Is the Nitrite in compliance?

3. Is the NFDM in Compliance?

4. Can this product be labeled "Liver Sausage"? If not, why?

5. In what order should the ingredient statement read?

Use the next page to show your calculations.

SAUSAGE FORMULATION GLOSSARY

Batch¾ An industry term that refers to all the ingredients in the formulation.

Binding—The ability of sausage emulsion components to emulsify fats as well as water.

Bladders—The urinary bladders of slaughtered animals, which are generally used as casings for stuffing some sausage products.

Bungs—The terminal end of the large intestines of slaughtered hogs, they are generally used as casings for stuffing some sausage products. Refers to the cecum or blind gut when derived from cattle.

Certified Trimmings (Certified pork)¾ Pork trimmings or pork that has been frozen to ensure destruction of any live trichinae in the pork muscle and certified by the FSIS inspection program employee.

Cold Spots—The area or areas within a smokehouse that are not exposed to as much heat as the rest of the smokehouse.

Communition (Comminuting)¾ The cutting, chopping, or grinding of meat or poultry into small particles.

Condimental Substances— Nonmeat ingredients such as spices, seasonings, and flavorings that are added to sausage product.

Emulsion—The combining (by chopping) of solubilized proteins and sometimes water to form a capsule around fat particles.

Encapsulate—To encase in a capsule; surround with a gelatinous or membranous envelope.

Emulsion Breakdown— The separation of components making up an emulsion. (When separation occurs during cooking, as is the usual case, breakdown products are fat, gelatin, and moisture.)

Fat Cap (Fat Capping)¾ The accumulation of unbound fat at the ends of finished sausages, usually occurring from an emulsion breakdown.

Greasing Out— A term used to describe emulsion breakdown. The fat is no longer held in suspension. Too little protein or too much heat in the product usually causes it.

Hydroflake—The method of thinly slicing or flaking frozen boneless meat or poultry preparatory to grinding.

Imitation Sausage¾ A term used to describe a product that resembles a sausage, yet does not meet the required standard of identity for that sausage, e.g., too much water, too much fat, etc.

Jungle, The—A novel by Upton Sinclair, exposing many questionable packing house practices during the late 1800's. A novel that should be required reading for every FSIS inspection program employee.

Meat— See §301.2(rr)

Meat Byproduct-—See §301.2 (tt)

Meat Block—The amount of meat, meat byproducts, poultry, and/or poultry byproducts used to make a specific sausage batch.

Middles—Derived from the large intestines of slaughtered animals; generally used as casings for stuffing some sausage products.

Myosin—A major protein in muscle tissue.

Off-Condition Meat—Spoiled meat.

Over chopping— Excessive cutting of a sausage emulsion during preparation, principally the fatty materials, resulting in an unstable emulsion.

Partially Defatted Tissue —Beef or pork tissue subjected to a low temperature rendering (120ºF or less) to remove fat but *not* to denature protein; limited to a usage level of 15 % in the meat block of products in §319.180.

Peelability—The removal of inedible casings from sausages; usually referring to the removal of celulosic casings from frankfurters without tearing the frank itself.

Permeable—Capable of penetration from the inside and outside

pH¾ The negative logarithm of the effective hydrogen ion concentration or hydrogen ion activity in gram equivalents per liter; used in expressing both acidity and alkalinity on a scale with values from 0 -14, with 7 representing neutrality numbers less than 7 increasing acidity, and numbers greater than 7 increasing alkalinity.

Protein 1 Materials (Group 1 protein-contributing ingredients)¾ All ingredients of slaughtered livestock or poultry origin from muscle tissue that is skeletal or that is found in the edible organs, with or without the accompanying and overlying fat, and the portions of bone, skin, sinew, nerve, and blood vessels that normally accompany the muscle tissue and that are not separated from it in the process of dressing. Examples include: meat byproducts, poultry products, and mechanically separated (species). *Exception*: meat byproducts and poultry products derived through hydrolysis, extraction, concentrating, or drying *will not* be classified as protein 1 material.

Protein 2 Materials (Group 2 protein contributing ingredients*)*— All protein-contributing ingredients of slaughtered livestock or poultry origin that have been processed by hydrolysis, extraction, concentrating, or drying, *and any other* ingredient that contributes protein. Examples include: plant products, dairy products, egg products, yeast products, or their derivatives.

Rework—The term applies to fully or partially processed product (not including uncooked trimmings and bacon ends and pieces) rerouted for reasons other than unwholesomeness or adulteration and intended for inclusion in cooked sausages, loaves and similar products.

Rounds—The animal casing derived form the small intestines of slaughtered animals (beef, sheep, calves, swine).

Short Out—Another term meaning an emulsion breakdown.

Trichinae (Trichinella spiralis) — A small, slender nematode worm that in the larva state is parasitic in the voluntary muscles of flesh-eating mammals such as man and hogs.

Variety Meats—Those meats previously referred to as meat byproducts. The term “variety meats” is usually used on meat labels to describe any meat byproducts contained in the meat product.